DOCUMENT RESUME

ED 112 621 EC 080 086

AUTHOR Collette-Harris, Martha; Minke, Karl A.
TITLE A Behavioral Experimental Analysis of Dyslexia.
PUB DATE [75]
NOTE 26p.; Paper presented at the International Federation of Learning Disabilities (Second International Scientific Conference, Brussels, Belgium, January 3-7, 1975); Best copy available

EDRS PRICE MF-$0.76 HC-$1.95 Plus Postage
DESCRIPTORS *Behavior Change; *Dyslexia; Exceptional Child Research; Learning Disabilities; *Operant Conditioning; *Remedial Reading; *Teaching Methods
IDENTIFIERS *Staats Action Reading Technique

ABSTRACT

Two groups of six children (aged 9 and 10 years) were given either traditional remedial reading treatment or behavioral therapy consisting of the Staats motivated Action Reading Technique. The method involved positive reinforcement for correct responses during three phases of instruction: individual word phase, oral reading phase, and silent reading and comprehension phase. Both dyslexic and non-dyslexic Ss receiving the behavioral intervention significantly improved in reading achievement to approximately the same degree, and the dyslexic Ss improved in several perceptual and attentional measures as well. Results supported the theory that dyslexia can be viewed as a function of deficient learning history. (Author/DB)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED112621

MARTHA COLLETTE-HARRIS, & Karl A. Minke
Psychology Department
University of Hawaii

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

BEST COPY AVAILABLE

A BEHAVIORAL EXPERIMENTAL ANALYSIS OF DYSLEXIA

Dyslexic children learn adequate reading skills, if at all, only with great difficulty. Dyslexics and other children with severe reading problems comprise 15% of the school-age population (HEW, 1969). It is often suggested that such children remain dyslexic in spite of training (Critchley, 1970). Therefore, they are expected always to have deficient perceptual and attentional skills, uneven ability to concentrate and labored reading. Dyslexia is widely believed to be a neurological problem stemming from a genetic origin (Critchley, 1970), from a developmental lag (Bender, 1957,1959; de Hirsch, 1963; Drew, 1956), or from minimal brain damage (Kawi & Pasamanick, 1959; Myklebust & Boshes, 1971; Prechtl & Stemmer, 1962) or a combination of such factors (Ingram, Mason & Blackburn, 1970; Rabinovitch, 1959; Silver & Hagin, 1960).

Empirical studies on dyslexia find several associated deficits with some regularity. The cardinal aspect is inability to read normally in a child with adequate intelligence, despite conventional instruction and socio-cultural opportunity (World Federal of Neurology, 1970). Among problems with reading, dyslexics make particular types of errors more frequently than normal children, such as reversals, transpositions and rotations in reading, writing and spelling tasks (Critchley, 1970; de Hirsch, 1957; Ginsburg & Hartwick, 1971; Money, 1962; Myklebus & et al.,

EC 050086

1971; Silver & Hagin, 1960). Comparatively worse performance on the verbal scales of the Wechsler Intelligence Scale for Children (WISC) is generally found (Ackerman, Peters & Dykman, 1971; Doehring, 1968; Myklbust, Bannochie & Killen, 1971; Rabinovitch, Drew, de Jong, Ingram & Withey, 1954). Poor perceptual skills and deficient attention span and focus are also commonly reported for dyslexics (Bender, 1954; Doehring, 1968; Dykman et al., 1971; Fuller, 1964; Ingram et al., 1970; Silver & Hagin, 1960; Stavrianos, 1971; Tjossem, 1962).

The first author (Collette-Harris, 1974) has applied a learning analysis to the behavior of dyslexics and advanced the idea that an inadequate learning history could more profitably explain the verbal, attentional-perceptual and reading deficits characteristic of dyslexics. If this analysis is correct, it would suggest that these deficits need not be permanent but should be modifiable through the appropriate application of learning procedures. Recent behavior modification studies demonstrate the successful application of techniques developed from learning theory to a wide range of behaviors. While behaviors peripheral to the desired end set of skills were often targeted in the early phase of this research, emphasis now is shifting from disruptive behavior (Martin, Burkholder, Rosenthal, Tharp & Thorne, 1968; Meichenbaum, Bowers & Ross, 1968; O'Leary & Becker, 1967) to more specific desirable behaviors, such as correct responses on cognitive tasks (Smith, Brethrower & Cabot, 1969), academic tasks (McKenzie, Clark, Wolf, Kotheru & Benson, 1968; Nolen, Kunzelman & Haring, 1967; Wolf, Giles & Hall, 1968), attention span (Wagner & Guyer, 1971) and reading responses (Ryback & Staats, 1970). Although behavior modification is being used to increase adequate academic performance of children with learning disabilities (Bradfield, 1971; O'Leary & O'Leary, 1972), its tremendous potential as a research tool to

investigate the learning process and disability syndromes has not been tapped.

The present research was undertaken less to demonstrate the efficacy of behavior modification techniques or learning principles than to explore the nature of a common and crippling deficit widely believed to be of neurological origin. Learning theory and the particular cognitive behavior modification technique used were therefore not at issue; instead, empirical knowledge on the behavioral syndrome of dyslexia was sought. Previous research based on the assumption that dyslexics continue neurologically handicapped despite apparently successful reading training (Critchley, 1970) has proliferated compensatory remedial techniques which foster perpetuation of the syndrome. A circular progression of perceptual inadequacy, for example, can be suggested to result from methods which teach a child with marginal perceptual skills through alternative channels, sacrificing further opportunity for improving his inadequate skills. The present study tests the assumption that dyslexic behavior is subject to the laws of learning and seeks to explore the associational, correlational or causative nature of the major elements of the syndrome. The specific hypotheses explored in this study are that the deficiencies characterized as central in dyslexia, underachievement in reading, limited attention span and poor visual and auditory perceptual ability can be improved through the application of a functional reinforcer system.

Ordinarily, research on dyslexia has been content to show that under some extraordinary conditions or method, reading improvement can be demonstrated. Uncertainty over questionable diagnoses is quelled by extensive evaluations of the dyslexics on tests tapping these central deficiencies listed above, before the experimental manipulation. After

the experiment, tests are done to determine whether reading ability is improved. The other major indices of dyslexia are not examined. The reason for this narrowly circumscribed approach becomes apparent when the underlying assumptions deriving from the neurological view of dyslexia are made explicit. If inability to read results from neurological, fixed, organic factors (stemming from genetic, brain-damage, or cortical immaturity origins), reading training is not expected to alter the neurological status. At best, perhaps through the use of more adequate channels, a compensation can be achieved. Nonetheless, the dyslexic child is expected to stay dyslexic (Critchley, 1970), with continued short attention span, poor visual and auditory perception and uneven ability to concentrate.

On the other hand, if dyslexia results from an inadequate learning and reinforcement histroy, rather than from genetic or biological variation, the major deficiencies of the syndrome must be subject to the laws of learning. Therefore, if these behavioral deficits are functional rather than organic, we may examine them after the experimental manipulation to determine their correlational, invariant or associative nature. To the degree that these deficits are functional, and importantly associated with reading acquistion, successful cognitive behavior modification of reading should produce improvement in attentional and perceptual ability also.

Experimental elements often lacking in behavior modification studies are thejudicious use of well-matched controls in between-subjects designs, carried out after stable baseline measures, full asymptotic performance, and reversals of independent variables. The present research attempts to meet these experimental considerations, as well as the caveats noted by Baer and his colleagues (1968) and by Hanley (1971), and by O'Leary

and Drabman (1971), such as the necessity of a well-validated token reinforcement method with explicit procedures, well-defined contingencies and important, relevant target behaviors. This is accomplished by utilizing the Staats cognitive behavior modification procedure to attempt to alter the various behavior deficits of the experimental subjects. It is sometimes objected that the diagnostic categories employed in dyslexia studies are so broad and vague as to prevent knowledge of the generality and applicability of the findings. Therefore, in the present study, dyslexia is narrowly construed, with explicit operational guidelines for the inclusion of subjects. Tentative reports without such guidelines are frequently discarded out of hand by other workers in the field who object that the target population was merely learning disability children, or those who in fact have subnormal IQ's.

The Staats token reinforcement method was given to matched groups of dyslexic and nondyslexic reading-retarded children. In addition, two other matched groups received reading training in a non-affiliated, private, eclectic reading clinic, thereby permitting comparisons of the differential effects of behavior modification versus traditional methods for dyslexics and normal children of matched IQ with no outstanding problems other than very poor reading. Beyond indices of reading ability, standardized tests of visual, auditory, attentional, and perceptual-motor ability were administered to all subjects prior and subsequent to the experiment.

METHOD

Subjects

Six experimental (token reinforcement) subjects and six control

(reading clinic) subjects participated in the project. Three of the six subjects under each condition were dyslexic (TRD and RCD), with the remaining three nondyslexic (TRND and RCND) as defined below. Three of the experimental subjects were referred by a state diagnostic and referral agency for learning disabilities and three by school counselors. The six control subjects had enrolled in a private, remedial reading clinic with an eclectic, individual-centered reading approach. All subjects were tested in a room in the same building where the training was held by an examiner. Experimenters were blind with respect to test scores and diagnostic conditions. The experimental group was comprised of three males and three females with mean age 9.11 years and WISC IQ, 101; the control group consisted of six males with a mean age of 10.3 years and WISC IQ, 100.83. Experimental and control subjects were matched for age, Full Scale Wechsler IQ, and degree of reading retardation as determined by the Spache Reading Diagnostic Test and the 100 Word Test developed by Staats (1964). The experimental group averaged 19.3 months below expected reading level, while the control group averaged 17.1 months below.

Diagnosis as dyslexic was based primarily on an average Perceptual Age twelve or more months below Mental Age as determined by WISC performance. Perceptual Age was determined by averaging scores on the two Auditory subtests, two Visual subtests, and the Memory for Designs subtest of the Detroit Tests of Learning Aptitude (Baker & Leland, 1959). Other criteria used were severe reading retardation (achieved reading score more than one year below expected level and school failure in reading) the Bender Gestalt Test, clinical evaluation (projective testing, handwriting, Harris Tests of Lateral Dominence),

discrepant Verbal and Performance scores on the WISC, characteristic pattern on the Digit Symbol and Coding subtests, and pediatric neurological examination (where available).

One exception to these restrictions occurred in the dyslexic experimental group, a subject whose Perceptual Age was only 6.4 months below his Mental Age. The subject was a certified learning disability case with a two and one half year reading retardation, extremely immature Bender performance, characteristic dyslexic handwriting (irregular letter size, formation, pressure on pencil, directionality and reversals), and greatly reduced visual perceptual scores. Perceptual Age quotient did not reflect the severity of his deficiency because his more nearly age-equivalent auditory subtest scores were averaged with the low visual subtest scores.

Individuals scoring above 80 or below 20 on the 100 Word Test were not included in the study; those scoring below 20 were considered essentially to be non-readers for whom intervention on more elementary cognitive skills would have been necessary. Excluded from consideration from either group were children whose reading retardation could be ascribed to primary mental retardation, frank organic involvement, emotional disturbance or sensory impairment.

Experimenters

The experimenters, or instructional technicians(I-T's), were undergraduate and graduate students from the employment lists of the University of Hawaii who were paid $2.00 per hour. Their training took place over several sessions lasting an hour and one half, under the super-

vision of the second author. Continued supervision of the I-T's was guided and standardized by the use of a checklist (Staats et al., 1967). The training included some experience in actually administering the materials, observing a trained I-T through a one-way mirror, and listening to tapes of previous experimental sessions.

Instruments

The 100 Word Test consisted of 100 words randomly selected from the reading materials (4254 different words) used in the experimental sessions. Prior use, validation, and complete descriptions of this test have appeared in the literature (Staats et al., 1967; 1969; Ryback & Staats, 1970). The Spache Reading Diagnostic scales were used to assess reading achievement. The particular scales used included Word Recognition, Instructional Level, and Independent Reading Level. From the Detroit Tests of Learning Aptitude the Auditory Attention for Words, Visual Attention for Objects, Designs, Auditory Attention for Syllables and Visual Attention for Letters subtests were administered as both pre- and posttests. As pretests only, the Bender Visual Motor Gestalt test (Bender, 1969) and the Draw-A-Person Test (Goodenough, 1962) were administered.

Reinforcer system for the behavior modification procedure, reading materials and procedures

Complete descriptions of the systems, materials, and procedures have appeared in the literature (Staats et al., 1965, 1967a, 1969; Ryback & Staats, 1970) and are also described fully in a manual (Staats, Van Mondfrans & Minke, 1967). For continuity, however, however, a brief description will be offered here. Three different color tokens

(poker chips) worth 1/10th, 1/5th or 1/2 of a cent were given to the subject contingent on different reading behaviors, redeemable for either cash or a pre-chosen gift at the end of the hour long sessions. The materials were developed from SRA (Science Research Associates) Reading laboratories at grade levels 1-2 through 4-D, with differing numbers of stories at each level to control for the systematic rate of introduction of new words. Materials were grouped in terms of the three phases of the Staats procedure for the lesson.

In the first phase, the Individual Word Phase (IWP), single typed words were presented on three by five inch cards in succession repeatedly until a criterion of one correct, unprompted response occurred. Correct reading of the word on the first trial resulted in receipt of a mid-value token; later correct attempts earned a low-value token. In the second phase, the Oral Reading Phase (ORP), paragraphs composed of words from that lesson and previous lessons were presented singly in succession until a criterion of one correct unprompted reading occurred, rewarded with a high-value token. Correct reading of the paragraph on a later trial was rewarded with a mid-value token. The third phase of the lesson was the Silent Reading and Comprehension Phase (SRP). The entire story was presented on a typed sheet to the subjects who read it silently and then answered written comprehension questions. Each correct response was rewarded with a high-value token. The subject received a mid-value token for responses corrected after re-reading the appropriate paragraph from the story. At intervals of 20 lessons, all new words presented in the previous 20 lessons were presented singly in the same manner as the words in the IWP. In this Vocabulary Review, unprompted correct reading of the stim-

ulus words was rewarded with a mid-value token if the response occurred on the first trial for that word. If the word was later read correctly after having been missed initially, a low-value token was awarded.

Control procedures

While less controlled and uniform, reading clinic procedures typically involved one third of the hour being spent on phonics, one third on basal reader and comprehension work and one third on either sight vocabulary or SRA Laboratory work. Each child's particular program was supervised by the clinic director after an extensive diagnostic testing and tailored to his particular deficiencies, resulting in an eclectic and variable program from child to child. Most subjects in the control condition spent a portion of their tutorial hour reading silently in basal readers at their level of achievement, in programmed workbooks stressing phonics analysis skills, in SRA Laboratoy work, in audio work such as Language Master exercises, with Dolch basic sight vocabulary words and in oral reading. In addition, several children who displayed marked difficulty in perceptual and attentional tasks worked in various enrichment programs such as the Frostig Program for the Development of Visual Perceptual Ability and the Lindemood Auditory and Oral Perceptual Enrichment Kit, Gattegno color language art materials, tactual-kinesthetic, tachistoscopic materials, etc. Precise specification of number of reading responses in particular stimulus situations is not possible due to the lack of program and content specificity and inter-subject variability.

RESULTS

Each of the experimental subjects (in both TRD and TRND groups)

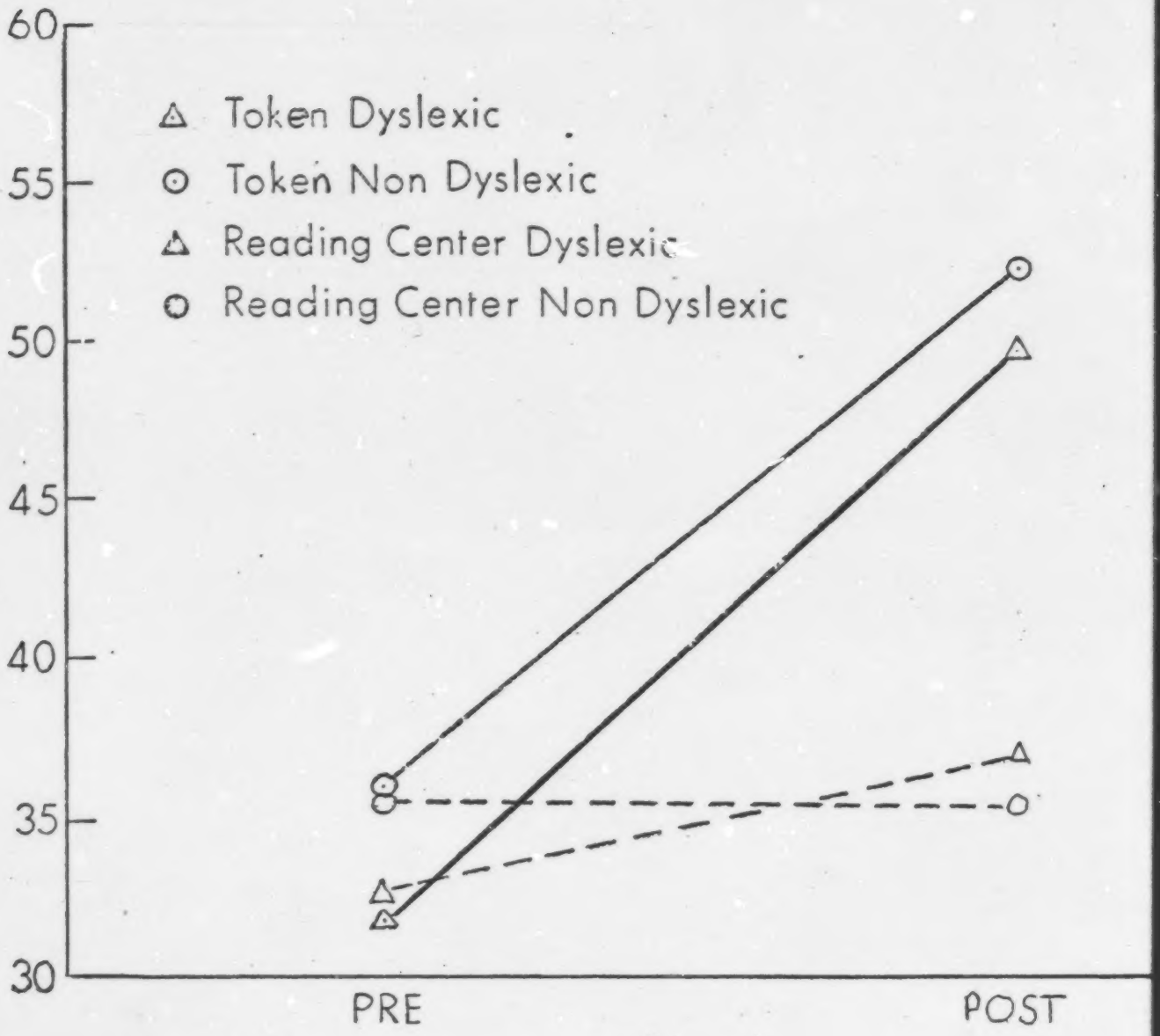
improved significalntly in reading ability as measured by the Spache Reading Diagnostic Scales, averaging as increase of 16.45 months, whereas for the control subjects at the reading clinic who received traditional remedial instruction, the comparable improvement was 1.28 months. This difference is significant at the .01 level. The cognitive behavior modification group including dyslexic and non-dyslexic groups improved in reading achievement well over an entire grade level for each of the three measures: Word Recognition, Instructional Level and Independent Level. Scores from dyslexic subjects, collapsed across experimental conditions (TRD and RCD), showed a mean of 10.22 months reading improvement, while non-dyslexic subjects (TRND and RCND) averaged 7.5 months. This difference did not reach significance. Therefore, improvement for the two groups, collapsing across training condition, is comparable. Change in reading ability over time for each of the four treatment by diagnostic conditions is seen in Figure 1, showing the mean pre- and posttest scores for all conditions. The mean pre- and posttest scores for each condition in the individual Spache Scales are displayed in Table 1.

For purposes of analysis a difference score was computed for each subject by subtracting his pre-test score from his posttest score. These data were then analyzed by means of a three-way mixed analysis of variance, with treatment condition, diagnostic category, and scale serving as the three factors. While the significant treatment effect from the analysis of variance indicates that the Staats procedure resulted in a significant increase in reading level over the control group, it is

of interest to ask if the control procedures resulted in any improvement in reading at all. In order to assess the effectiveness of the reading clinic intervention, a one tailed T-test of a single mean difference for the Reading Clinic Spache improvement scores (using the between error term from the analysis of variance) was conducted. The mean improvement of 1.28 months was significantly different from zero ($T(1,8) = 2.5766$, $p<.05$). Thus the reading center procedures were demonstrated to have some effect in producing reading achievement.

As in previous studies using the Staats procedure, the experimental subjects in this study exhibited excellent cooperation, attentiveness and work behavior over the 40 hours of their training, spread over two and one half months. In previous studies, training sessions lasted one half hour. In the present project, sessions lasted approximately one hour. The procedures were powerful enough to maintain attentive, diligent reading behavior for an hour at a time. Two of the six experimental subjects were shaped to one hour sessions over several sessions.

The second major result of the training was a statistically significant improvement in perceptual and attentional measures for each of the experimental subjects. The change over time in over-all mean perceptual scores for the TRD, TRND and corresponding reading clinic control groups is shown in Figure 2. Pre- and posttest mean differences for each of the five subtests for each treatment by diagnostic condition are depicted in Table 3. These data were also analyzed by means of a three way mixed analysis of variance. The token reinforcement procedures led to an increase in perceptual, attentional scores of 15.84 months for the TRD and TRND groups. The subjects in the reading clinic control condition showed a mean improvement of 2.20 months, a difference significant at the


60
55
50
45
40
35
30
Token Dyslexic
Token Non Dyslexic
Reading Center Dyslexic
Reading Center Non Dyslexic
PRE
POST

A BEHAVIORAL EXPERIMENTAL ANALYSIS OF DYSLEXIA

Martha Collette-Harris (U.S.A.) University of Hawaii

A behavioral analysis of specific dyslexia is contrasted with traditional genetic, neurological and developmental theories which hold that the dyslexic's inability to read in line with expectations based on intellectual functioning and decreased perceptual and attentional test scores are caused by a biological limitation. Two groups of six children aged nine and ten years comprised of dyslexic and non-dyslexic subjects were given either traditional remedial reading treatment or behavioral therapy consisting of the Staats motivated Action Reading Technique. Both dyslexic and non-dyslexic subjects receiving the behavioral intervention significantly improved in reading achievement to approximately the same degree and the dyslexic subjects improved in several perceptual and attentional measures as well. These results are taken to support the position advanced that the specific dyslexia syndrome is subject to the laws of learning and can be viewed as a function of a deficient learning history.

TABLE 1

Improvement in Months on Spache Reading Diagnostic Scales

Group	Scale			
	Word Recognition	Instructional Level	Independent Level	Total
TRD	13.000	20.000	17.000	16.670
TRND	15.667	17.667	15.333	16.220
RCD	5.333	4.000	2.000	3.770
RCND	-2.667	0.000	-1.000	-1.220

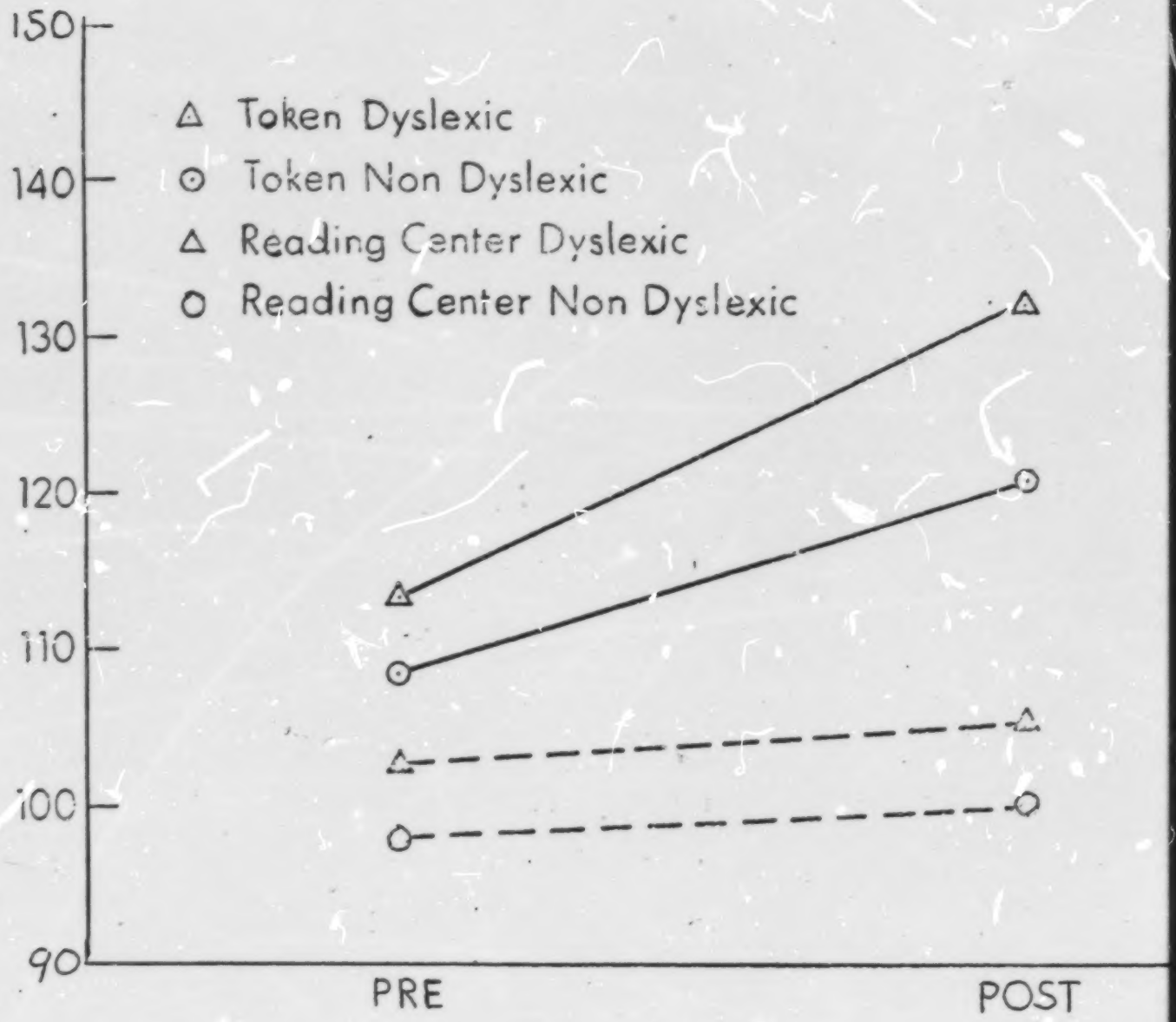

150
140
130
120
110
100
90
Token Dyslexic
Token Non Dyslexic
Reading Center Dyslexic
Reading Center Non Dyslexic
PRE
POST

Figure Caption. Figure 2. Detroit Test Score at Pre- and Posttests in Months

TABLE 3.

Mean Improvement in Months on Detroit Tests

Group	Test	Condition: Token reinforcement	Condition: Reading Clinic	Co
Dyslexics	Auditory (Words)	23.67	-4.00	
	Auditory (Syllables)	14.00	-3.67	
	Visual (Objects)	42.00	.33	
	Visual (Letters)	11.33	7.00	
	Designs	5.00	10.67	
Nondyslexics	Auditory (Words)	4.00	1.33	
	Auditory (Syllables)	3.00	3.33	
	Visual (Objects)	9.33	-18.00	
	Visual (Letters)	21.00	7.00	
	Designs	25.00	18.00	

TABLE 3

Mean Improvement in Months on Detroit Tests

Test	Condition: Token reinforcement	Reading Clinic	Combined
Auditory (Words)	23.67	-4.00	9.84
Auditory (Syllables)	14.00	-3.67	5.17
Visual (Objects)	42.00	.33	21.17
Visual (Letters)	11.33	7.00	9.17
Designs	5.00	10.67	7.84
Auditory (Words)	4.00	1.33	2.67
Auditory (Syllables)	3.00	3.33	3.17
Visual (Objects)	9.33	-18.00	-4.34
Visual (Letters)	21.00	7.00	14.00
Designs	25.00	18.00	21.50

.05 level of confidence ($F(1,8) = 6.481$). Classification as dyslexic and specific subtest did not contribute differentially to improvement scores. Thus, other main effects and interactions did not reach significance. The mean increase in all four groups on the Auditory Attention for Words was 6.26 months; for Auditory Attention for Syllables, 4.17 months, for Visual Attention for Objects, 8.42 months; for Visual Attention for Letters, 11.59 months; for Designs, 15.17 months. For the TRD group, the mean improvement on these tests was 19.2 months; for the TRND group it was 12.47 months, a highly significant increase.

Detailed comparison by subject for each treatment by diagnostic conditions of posttest mean Detroit subtest scores in years with chronological age is seen in Table 5. Each subject's age is compared with his mean score from the five Detroit perceptual subtests. In each case in the TRD group the average Detroit score is within two months of chronological age level. In the reading clinic condition, dyslexic subjects are seen to average 28 months below chronological age level.

DISCUSSION

The hypotheses based on the view that specific dyslexia is a complex cognitive deficit due to inadequate learning history were supported in this study. The application of a functional reinforcer system in a cognitive behavior modification program based on the systematic application of learning principles resulted in significant remediation of the central indices of dyslexia, reading retardation and perceptual, attentional deficits. While total remediation of the reading deficit was not achieved, the improvement of 16.67 months in 40 hours of training is highly significant. Perceptual and attentional scores were brought to approximate chronological

age level. In other words, the effect of the experimental procedures was to produce age equivalent perceptual and attentional performance; from this result it can be seen that these dyslexic subjects would no longer be classified as dyslexic, or even learning disabilities cases, on standard examination. Moreover, they would escape the labeling process which according to recent evidence can have more harmful than beneficial effects for the labeled person (Lemert, 1967; Szasz, 1961). Clear, emperical guidelines for diagnosing dyslexia are often lacking. In the absence of such guidelines, the label dyslexic can be haphazardly attached, or shunned as lacking predictive, prognostic or theraputic value. Even in the face of direct evidence of inadequate emperical validity, clinicians' diagnostic interpretations are most resistant to change; for example, Goldfried and Ingling in 1964 showed evidence that Hutt and Briskins (1960) suggested interpretations of types of responses to the Bender Gestalt Test lacked emperical validity. Nonetheless, the 1968 revision of Hutt's manual continues to advance the invalid interpretations, as noted by Goldfried and Kent (1972). Thus, a valid, reliable diagnosis of complex abnormal behaviors is difficult to obtain with certainty (Goldfried & Kent, 1972; Goldfried & Pomeranz, 1968; Kanfer & Saslow, 1965).

The sequelae of even a valid diagnosis as dyslexic are less beneficial when the traditional neurological model is employed. If, as Critchley suggests, dyslexics remain dyslexic and continue throughout life to make characteristic errors inspite of apparent compensation, remediation efforts would appear futile. If a defect is construed as genetic or organic, it is not seen as ameliorable. Generally, the outcome of a differential complex analysis of abilities in the dyslexic is to pinpoint deficiency or a weak channel. Most remedial techniques favor teaching the child

through the strong channel. A circular progression of inadequacy can be seen to result if, for example, for the child with poor visual perception, further opportunity to improve visual skills is sacrificed.

The substantial nature of the effectiveness of this method is underlined by the fact that for severly reading retarded children, a negatively accelerated learning curve is generally found. That is, with each successive grade level, a smaller increment of learning occurs. Continuation of the token program might be expected to produce reading at grade level for these subjects. Further experimentation is required to determine the amount of time and course of training required to produce grade level reading.

While explicit measures are unavailable on other common behavioral factors of dyslexia, such as inability to concentrate, fluctuation of attention span and hyperactivity, subjects all displayed a high degree of sustained, attentive participation in the reading learning situation over hundreds of learning trials. A proportional decrease in inappropriate behaviors is likely the logical consequence of the increase in appropriate reading operants available and their motivated use. Actual empirical measures in subsequent experiments may confirm this hypothesis. Therefore, it is heuristic to state the hypothesis more explicitly. Hyperactive, disruptive and inappropriate behaviors which often result in an administrative decision to remove a child from the normal school classroom, may be most successfully overcome not by extended efforts to deal with them directly, but instead by programs which increase the availability of appropriate behaviors. Disruptive and inappropriate behavior is still the most frequently observed target of applied behavioral analysis techniques (Hanley, 1971; O'Leary and Drabman, 1971) and some of the best psychological

efforts have been directed toward such behavior. Many well designed and controlled token reinforcement programs (Kuypers, Becker & O'Leary, 1968; Martin et al., 1967; O'Leary et al., 1969) have reported reliable decrease in disruptive behavior after behavior modification through token reinforcement, but typically with no resulting improvement in academic achievement. Simply reinforcing a child for sitting quietly may be shaping day dreaming, inattentiveness, or any unspecified behavior, and certainly has an equivocal or undemonstrated relationship to a complex, cognitive behavior deficit. On the other hand, it has been shown here that dyslexic children can be trained to read, to attend, to achieve and in doing so to increase perceptual ability. The larger population of learning disability and behavioral disorder children might well benefit from the training not only in terms of increasing deficient appropriate behaviors, but also in terms of a proportional decrease in inappropriate behavior. In other words, perhaps the traditional approach of attempting to modify disruptive behavior in order to increase academic behavior is backwards. The more compelling alternative suggested here is training hyperactive, disruptive children to read and therefore achieve academically and gain access to the appropriate social reinforcers (grades, awards, achievement, approval, competition) in the classroom. In this way, it may be possible to reduce the frequency of their disruptive unacceptable behavior also.

In this study both experimental groups (TRD and TRND) improved to an equal degree on perceptual and attentional measures. In fact, as opposed to predictions based on neurological considerations, there was a slight advantage for the dyslexics (19.20 months for the TRD group

versus 12.47 months for the TRHD group). Statistically, the differences on entering between the two groups did not contribute to their differential ability to profit from the token reinforcement procedures in terms of improvement in abilities measured by the Detroit Tests. The fact that even this slight advantage was shown in the scores for dyslexics indicates a comparative acceleration of rate of learning or "learning to learn" phenomenon (Staats, Brewer & Gross, 1969). Continuation of the experimental procedures over a longer period of time would be interesting for this comparison, as well as for changes in the three WISC subtests often found correlated with dyslexia (Coding, Digit Span and Block Design), and their relationship to overall level of intellectual functioning.

According to the genetic position of Critchley concerning the etiology of dyslexia, these deficits should persist into adulthood; it might be advanced from this position that the dyslexics in this experiment were still dyslexic in fact, but merely "compensating." The invincibility of such a line of logic is its manifest weakness, however. To the analyst of behavior, making the hypothesis untestable by asserting that it is not measurable, or that measured differences do not indicate an inner change, is a relatively futile position. The position that dyslexia is a neurological, maturational lag suggests that the behavioral deficit of specific dyslexia is determined by a developmental, pre-mapped, individual, biological predisposition or sequence. It is not assumed here that there can be no neurological difference among dyslexic and non-dyslexic children; the issue becomes what are the appropriate means of changing the behaviors, and thereby eliminating the deficits usually attributed to neurological dysfunction. Here it has been demonstrated that a complex

behavioral repertoire is subject to manipulation by learning theory-based application of a functional reinforcer system over a relatively brief period of time in the life span of a child. If neurological, maturational differences can then be construed not as as an innate sequence of biological unfolding, but rather as a result of lack of learning, possible neurological differences can be expected. Thus the conclusion from this line of reasoning is that when conditions of learning, particularly reinforcement variables, are appropriately arranged, learning takes place, leading to neurological "maturation" and attenuation of the lag in different abilities.

In summary the fact that these procedures exerted equal control over dyslexic and non-dyslexic children who were severely reading retarded suggest that the diagnosis of dyslexia according to perceptual/IQ relationships, specificity, and the dyslexia syndrome is not meaningful in terms of reading remediation and underlines the importance of increased motivation, attentional behavior and immediate reinforcement of effortful reading behaviors to produce reading achievement. The reading deficits traditionally viewed as being due to genetic predisposition, MBD and/or neurological lag are more productively viewed as learning history deficits.